

## DAUB: BETWEEN POTTERY AND SEDIMENT

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**Abstract:** *The paper presents the summary of the archaeometrical investigation of Neolithic daub fragments from two archaeological sites (Vörs and Kup, in Transdanubia, Hungary). Petrographical, mineralogical and geochemical methods were used for the analysis and local soil samples, collected from the archaeological sites and ceramic samples from Vörs were used for comparison. The daub fragments can be classified mostly on the basis of their textural features. No significant differences can be found among the building technologies of different sites and cultures. Local raw material was used for the production of the daub, while the raw material of the ceramics is different.*

**Keywords:** *daub, Western Hungary, Neolithic, petrography, geochemistry*

### INTRODUCTION

A complex archaeometrical investigation of Neolithic daub fragments from two archaeological sites (Vörs and Kup, in Transdanubia, Western Hungary, **Fig. 1**) was carried out.

Daub is the term used for different parts of a wattle-walled house (wall, floor, kiln), which can be preserved by occasional or intentional burning of the building. Considering the raw material – fine-grained sediments – and the preparation – the use of artificial temper without intentional burning – daub is indeed somewhere between the sediment and the pottery so their comparison may provide additional information about the preparation of both artefacts. Despite the fact that it is a common and frequent object at most archaeological sites, in Hungary it has not been commonly studied yet – from the archaeometric point of view.

Architectural and ethnographical aspects of these finds have been treated by Hungarian experts extensively (Barabás & Gilyén 1987; Sabján & Buzás 2003; Istvánfi 1997). Complex lithological and geochemical investigation of daub and any other clay artifact fragments has not been so common in archaeometric research (Karanth *et al.* 1986; Bonzon 2001; Di Pierro 2003, Huston & Terry 2006; Starnini & Szakmány 2007).

The main target of this research was to collect information about the building technology of the wattle-and-daub houses, tracing possible differences between the building traditions of different cultures and localities, to investigate the possible raw materials and to make a preliminary comparison of daub to other, intentionally burnt earthenware (ceramics) on the same sites.

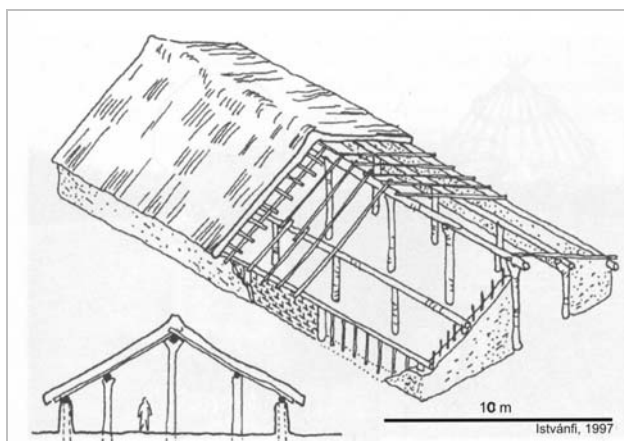
### ARCHAEOLOGICAL BACKGROUND

The archaeological sequence of both the Vörs-Máriaasszony-sziget and the Kup-Egyes sites include several cultural horizons, Early Neolithic to the Middle Ages in the former case and Linear Pottery, Lengyel and Pre-Boleráz Cultures in the latter. However, the samples investigated during this work originated only from the Early Neolithic Starčevo and Late Neolithic/Early Copper Age Lengyel Cultures at Vörs (collected by Katalin T. Biró and Zsuzsanna Virág in 1999 and 2000) and from the Lengyel culture at Kup (collected by Katalin T. Biró and Judit Regénye between 2000 and 2003).

At both sites the concerned cultures used quite similar domestic architecture with plastered wattle walls, the building technology of which involved building a wooden frame of securing posts first, then a wattle frame of smaller branches and twigs, and finally applying clay with vegetal or chaff tempering to the frame on the inside



**Fig. 1** Location of the two sites



**Fig. 2** Reconstruction of a Neolithic house in the Carpathian Basin. (Istvánfi 1997)

and outside of the structure to close in the spaces and form the walls (Patel 2004) (Fig. 2). The walls of these structures were sometimes decorated with incisions and painting (Kalicz & Raczky 1987).

The archaeological assessment of both sites is in progress. Preliminary publications were presented on archaeological aspects and also on pottery archaeometry (Kalicz et al. 2002, Biró et al. 2007, Biró—Regenye 2004). C-14 dates were obtained so far for Vörs only, ranging between 5540-5360 BC for the Starčevo Culture (see Kalicz et al. 2002 and manuscript report by Éva Svingor, to be published in the site monograph.). No C-14 are available for the Lengyel finds as yet.

## MATERIALS AND METHODS

Approximately 500 samples were collected and investigated altogether from the two sites. After macroscopic observation and description the samples were classified in respect of colour, morphological features (e.g. smoothed, painted surfaces, prints of structural elements etc.), porosity and average grain size. After this we chose 40 samples for more detailed analysis; representing equally all the later described macroscopic groups.

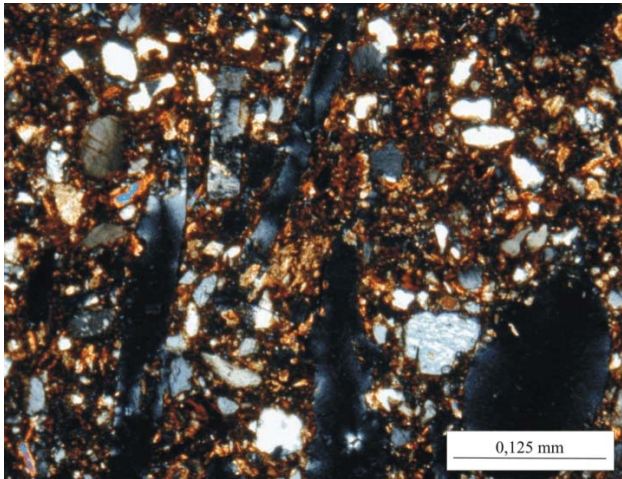
The petrographical investigation was based on binocular microscope and thin section analysis using polarizing microscope. The thin sections have a thickness of 30  $\mu\text{m}$ . The clasts were determined qualitatively and semi-quantitatively as well, the later on 3-4 representative samples from every group. The quantitative method included volume determination and for the estimation a measurement grid was used.

For further specification of the mineralogical composition X-ray powder diffraction (XRD) was employed, chemical composition was determined by neutron activation

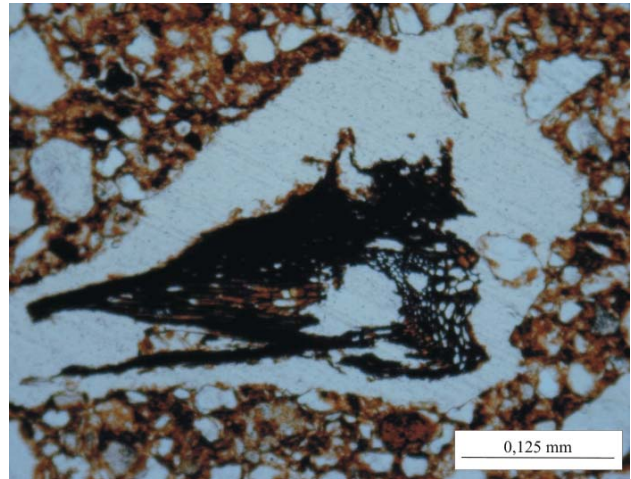


**Fig. 3** Macroscopic photographs of daub samples of the 3 groups from the Kup-Egyes site: a) floor fragments: low porosity, coarse grain size (sample no.2.2.1/2); b) wall fragment: high porosity, vegetal remains (sample no.4.5.8/1); c) kiln fragment: low porosity, pebbles on the bottom (sample no.1.6.3/1).

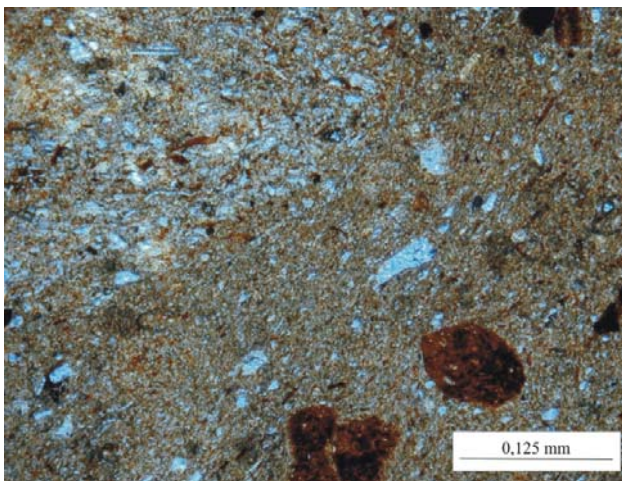
analysis (NAA) and X-ray fluorescence analysis (XRF). To examine the texture of the daub and the chemical composition of the minerals, scanning electron microscope and energy dispersive spectrometer (SEM-EMPA) was used.



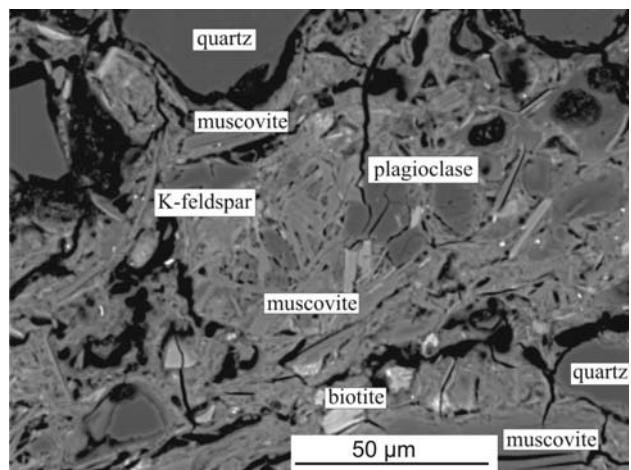
**Fig. 4** Microphotograph of a daub sample with coarse grain size, high non-plastic component/matrix ratio and high porosity. The reddish matrix contains well-rounded quartz grains (grayish grains), some mica and rock fragments. The elongated pores (black ones) preserve the shape of the former plant fragments. 1 nicol.



**Fig. 6** Microphotograph showing a carbonized plant residual in the daub. 1 nicol.



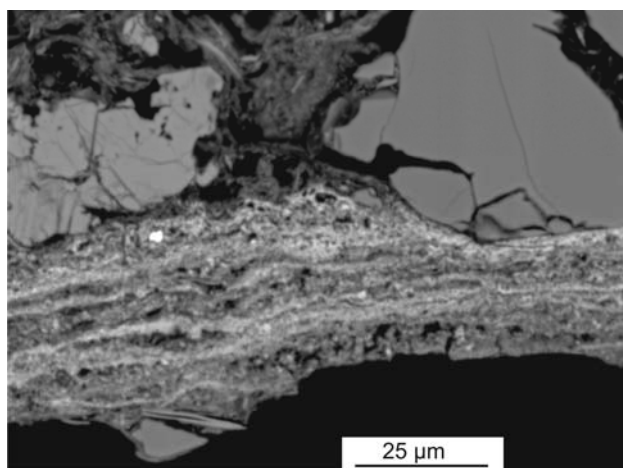
**Fig. 5** Microphotograph of a daub sample with very fine average grain size, low non-plastic component/matrix ratio and low porosity. The very fine grained matrix contains some quartz grains and reddish clay pellets. + nicols



**Fig. 7** SEM micrograph showing the mineralogical composition of the very fine grained matrix. The labeled grains (except for the larger quartz grain on the top) belong to the matrix.

The X-ray diffraction analysis was carried out by the Institute for Geochemical Research of the Hungarian Academy of Sciences on a Philips PW 1730 diffractometer with a Bragg-Brentano alignment, the XRF analysis at the Department of Geochemistry of the University of Tübingen (Germany) and the NAA at the training reactor of the Institute of Nuclear Techniques (Budapest Polytechnical University). For the details of the description of analytical methods see *Gherdán et al. (2007)*.

In addition to daub, 4 soil samples (3 from Vörs and 1 from Kup) were collected from the sites during the excavations, from the same objects as the examined daub artefacts, and from shallow bore-holes, drilled in the undisturbed part of the localities. These samples were also examined with binocular microscope and analyzed by X-ray powder diffraction. Moreover, in the case of the Vörs site we had the possibility to use unpublished data on the ceramics to compare their chemical composition to the daub, the ceramics and the soil samples.



**Fig. 8** Photograph taken by scanning electron microscope showing the white painting layer on the surface of a daub sample

## RESULTS AND DISCUSSION

### *Petrography*

The classification of the fragments was based on textural features - grain size, porosity - measured with the thin section analysis - and non-plastic component/matrix ratio, amount of organic tempering. The microscopic analysis proved the reliability of the macroscopic groups, which are the followings: (i) group of compact, low porosity (1-3%) samples with relatively coarse (silt-fine-sand) grain size and with scarce vegetal remains – fragments of the floor; (ii) group of samples with higher porosity (8-15%), silty average grain size and with a large amount of vegetal remains – fragments of the wall; (iii) samples with a layer of 0,5-1 cm large pebbles on the bottom and with low porosity (1-3%) – fragments of kilns. In most of the groups smoothed, occasionally painted surfaces can be found on some fragments. The three groups are identical at both sites. In **Fig. 3** one example of each group of the Kup site is shown.

The mineralogical composition of the daub samples is very homogenous on both sites and within all the groups, the results of the semi-quantitative analysis of the non-plastic components are given in **Table 1**. The differences between the two sites clearly originate from the different sedimentology of the areas.

In each group, the grain size and the quantity of the non-plastic clasts in the matrix can be very diverse (**Fig. 4, 5**) even in one piece, but their distribution is serial. There are no signs of artificially added non-organic temper except for burnt, maximum 1 mm large fragments of former plasters or ceramic fragments.

**Table 1** Mineralogical composition of the non-plastic components of the daub samples: average values of the two sites

Non-plastic components (NPC) >15 µm	Vörs (n=3)		Kup (n=3)	
	average	st.dev.	average	st.dev.
Monocrystalline quartz (v%)	66,4	1,59	55,2	1,6
Polycrystalline quartz (v%)	7,7	6,64	14,0	3,3
Mica (v%)	10,4	8,71	6,5	1,0
Feldspar (v%)	4,0	3,44	6,4	0,7
Rock fragment (v%)	3,6	3,30	12,5	2,2
Opaque minerals + organic material (v%)	8,0	6,18	5,3	1,9
Accessories (v%)	Traces		traces	

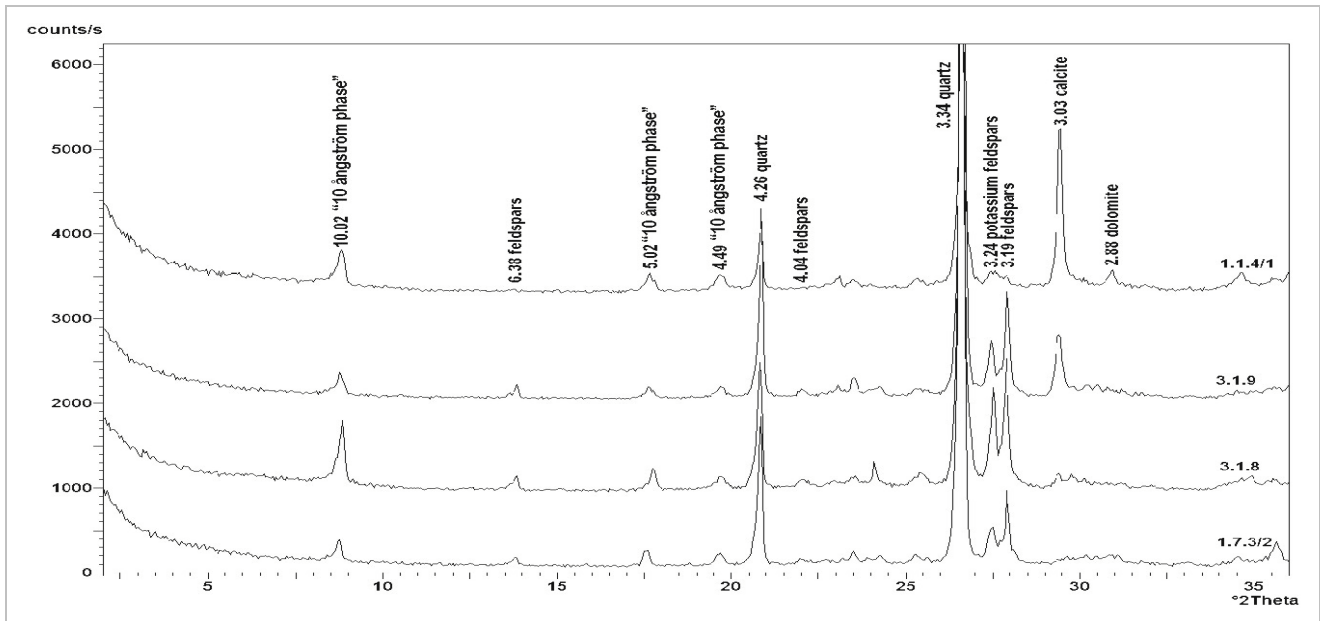
On the other hand the use of organic tempering is proved by the presence of carbonized plant remains (**Fig.6**), the amount of which may vary significantly and was an important parameter for the classification.

Based on the observations by SEM-EDAX the very fine-grained matrix consists of 10-20 µm size grains of the same types of minerals as the larger non-plastic components (**Fig. 7**) and various amounts of disperse carbonate. With this technique we could find another type of organic material in the samples – identified by their high phosphorous content – in the form of irregular shaped nodules of 100 µm scale, which may be of animal or vegetal origin.

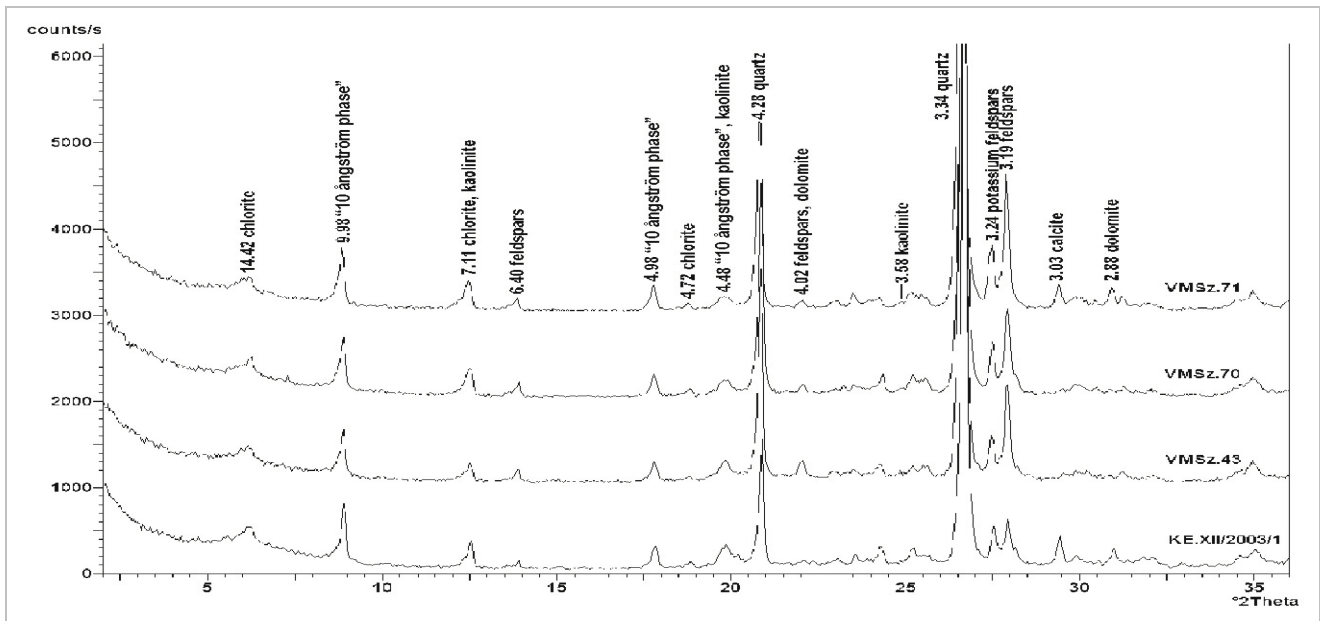
The white painted layer with a thickness of a few 10 µm has a chemical composition similar to apatite, which suggests bone grist as raw material (**Fig. 8**) the use of which was discovered at other archeological sites as well. (e.g. *Çolak et al. 2001*).

### *Comparison with local soils*

A granulometric and mineralogical investigation and comparison of the daub and soil samples of both sites were carried out by means of binocular microscopy and XRD analysis. In those parameters that can be observed with a stereomicroscope, such as the mineralogical composition and the roundness of the clasts, the daub and soil samples originating from the same sites proved to be similar. In **Figs. 9** and **10** the diffractograms of XRD analysis of four representative daub samples and four soil samples can be found. The analysis has proved that they contain approximately 70% quartz and smaller quantities of micas (the 10Å phase), feldspars and in some cases, carbonates (calcite and less dolomite).



**Fig. 9** X-ray diffractograms of four representative daub samples. (1.1.4/1 and 1.7.3/2 from Kup-Egyes site; 3.1.8 and 3.1.9. from Vörs-Máriaasszonysziget site)



**Fig. 10** X-ray diffractograms of four soil samples. ( VMSz. 43.; VMSz. 70., VMSz. 71. from Vörs-Máriaasszonysziget site and KE.XII/2003/1. from Kup-Egyes site)

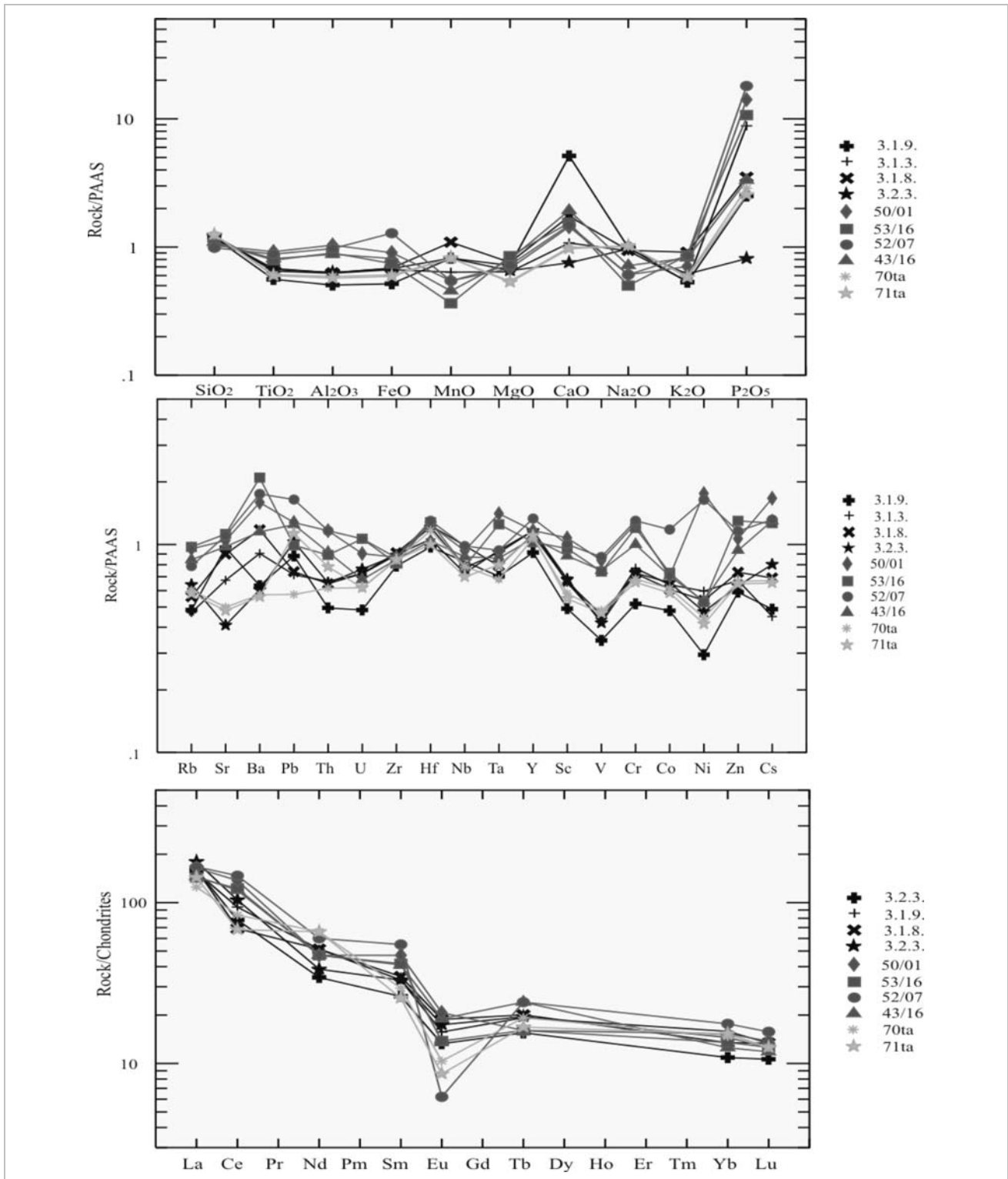
*The only differences emerged in the clay mineral content of the daub and the soil samples: there are no clay minerals in the daub, not even in the <2 μm fraction but significant amount of smectite, chlorite, sometimes kaolinite phases were detected in the soil samples.*

*Comparison with local ceramics*

The target of the chemical analysis was the comparison of the daub with the soil and ceramic samples of Vörs-

Máriaasszonysziget site, where the chemical analysis of soil samples and ceramics of the same cultures was available (Gherdán K. unpublished data).

Main and trace elements are compared to Post-Archaean Australian Shale (Taylor and McLennan 1985), as the most widespread normalized values of mudrocks and REE are compared to chondrite data (Sun and McDonough 1989). The results of the chemical analysis and comparison are shown in Fig. 11.



**Fig. 11** PAAS normalized major, trace and chondrite normalized REE distribution of daub fragments (3.1.3., 3.1.8., 3.1.9., 3.2.3.), pottery (50/01, 53/16, 52/07, 43/16) and soil (70ta, 71ta) samples from Vörs-Máriaasszonysziget. PAAS normalization values are from Taylor & McLennan (1985), and chondrite normalization after Sun and McDonough (1989)

The major element composition of the daub and soil samples proved to be very similar to each other, while the ceramics are different. Higher variations manifested in the amounts of Ca and P. The variation in the quantity of Ca surely originates from the alternating carbonate content of both the daub and the possible raw material, the soil, which suggests that different raw materials were used during the manufacturing. The generally high amount of phosphorus may depend on the technology of the fabrication, but also of later metasomatic effects due to the burial conditions etc.

The trace elements have higher variation but the tendencies are the same between daub and soil, as shows the similar distribution of the immobile trace elements.

The REE distribution is quite similar in all the cases, meaning a significant increase in light REE and small increase in heavy REE and a negative Eu anomaly. This distribution is typical for fine grained siliciclastic rocks and the upper continental crust.

The different composition of the ceramics suggests that a different raw material was used or more types of clay were mixed for the ceramics. The higher Al and immobile element content of the potteries compared to those of plasters is probably due to their higher clay content.

## CONCLUSIONS

- there are no significant differences between the daub of the two sites and the different cultures
- vegetal (and animal?) organic material was added to the raw material but there are no signs of inorganic temper
- the carbonate content of the raw material had no importance in the different types of daub
- the clay mineral content of the raw material is missing but the clay-size fraction of quartz, feldspar and mica may have an importance in the stability of the wall
- bone grist was used as painting material
- the fire, which preserved the daub, probably wasn't intensive as there are no significant traces of burning
- the raw material of the daub was probably the local soil but the ceramics – at the investigated Vörs site – were made of different raw material

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